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(54) Laundry washing machine.

(57) A laundry washing machine comprising a washing chamber and a washing liquid collector receptacle connected to a lower portion of the washing chamber, and to an upper portion thereof through an electric pump and a recirculation conduit.

According to the invention the collector receptacle is adapted to accommodate a heater element and two thermostats adapted respectively to control the heating of the washing liquid to different temperatures and to prevent overheating of the heater element in the case of possible malfunction of one thermostat and/or of a pressure switch. During operation of the electric recirculation pump, the washing liquid is recirculated through the recirculation conduit, while part of the liquid is returned to the collector receptacle to thereby set up a turbulent flow therein for ensuring uniform heating of the liquid.

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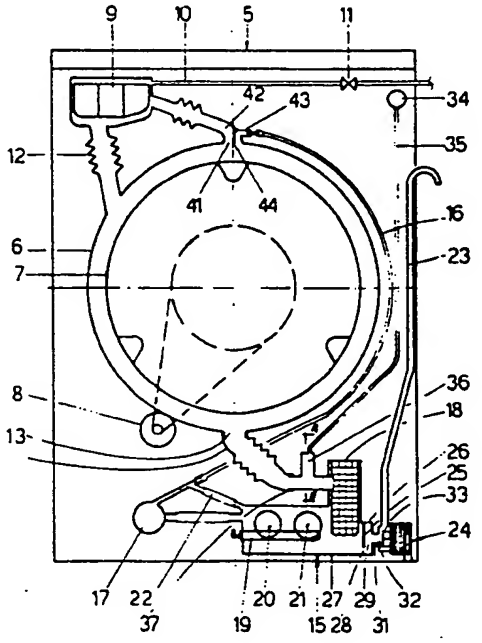

FIG. 1

Laundry Washing Machine

The present invention relates to a laundry washing machine of the type in which the washing of the laundry is carried out by the irrigation thereof with a washing liquid collected in a receptacle communicating with lower and upper portions of a washing chamber in a recirculation system.

Known from European Patent Application No. 0146719 is a laundry washing machine of this type in which the collecting receptacle for the laundering liquid houses at least one filter element für filtering the washing liquid, an electric heater element for heating the liquid and a thermostatic sensor of conventional construction for monitoring the temperature of the liquid.

Laundry washing machines of this type are further provided with an electric recirculation pump and a discharge pump connected respectively to the recirculation conduit and a discharge conduit of the machine for repeatedly recirculating the washing liquid from the collector receptacle to the washing chamber and for discharging the liquid at the end of the washing cycle, respectively. While on the one hand a washing machine of this type permits the laundry to be laundered efficiently with a reduced volume of washing liquid, resulting in corresponding savings of water, detergents and electric energy, they require on the other hand a highly accurate calibration of the thermostatic sensor and the accurate positioning of the sensor in the collector receptacle so as to ensure accurate control of the temperature of the liquid in the course of different washing programmes.

As the liquid in such a machine circulates through the collector receptacle in a substantially laminar flow, it tends to be heated in a stratified manner, that is to say, there is an increase of the temperature from the lower strata to the higher layers of the liquid.

For obtaining a satisfactory control of the temperature of the washing liquid in the collector receptacle, the thermostatic sensor is therefore empirically adjusted to respond to a temperature above that to which the liquid is to be actually heated, and is placed in the collector receptacle at the level of the higher layers of the liquid contained therein.

In particular, the responding temperature of the thermostatic sensor is selected to coincide with the heating of the washing liquid in the collector receptacle to a mean temperature corresponding to the temperature required for carrying out any specific washing programme.

This method of temperature control, which is usually carried out with the aid of a thermostatic sensor of the adjustable type, becomes rather critical in the case of washing programmes requiring the washing liquid to be heated to maximum temperatures of about 90 °C, in which case the upper layers of the liquid are heated to a temperature close to the boiling point, causing the liquid to progressively evaporate.

In such a case, even the smallest amounts of steam escaping from the closed system of the machine, for instance through a flexible hose interconnecting the collector receptacle and the washing chamber, may be sufficient to cause malfunctions in operation of the washing machine.

In particular, air bubbles formed in the washing liquid by the partial ebullition of the upper liquid layers may enter the intake of the recirculation pump to form an air-lock therein.

The steam may also enter the pressure-sensing dome of a pressure switch communicating for instance with an upper portion of the above-mentioned flexible connecting hose so as to progressively displace or entrain the air contained therein, resulting in an increasingly faulty response of the pressure switch.

Another shortcoming of known laundry washing machines of this type results from the presence of a filter element of the fine-mesh type capable of efficiently retaining dirt particles, lose fibres from the laundry and any possible foreign bodies of sufficiently great dimensions from the washing liquid, but incapable of retaining fibres, dirt particles and any detergent solids of very reduced dimensions, which will therefore be deposited on the bottom of the collector receptacle.

These fibres and particles will also be deposited on the heater element, to thereby progressively reduce the size of the effective heat exchange surface area thereof and thus the amount of heat transmitted from the heater element to the laundering liquid.

The detergent deposited on the bottom of the collector receptacle is itself lost to the laundering process and cannot be usefully reclaimed.

The above discussed laundry washing machines are finally not provided with any safety features as a protection against failure of the thermostatic sensor or the pressure switch responsive for instance a short-circuiting of the thermostatic sensor and/or to an insufficient filling level of the collector receptacle.

Under these circumstances the heater element would be continuously energized, resulting in a continuous rise of the temperature of the laundering liquid up to its boiling point. The thus excessively heated liquid in the collector receptacle would progressively evaporate, resulting in a further drop of the liquid level until the heater element would be exposed to air. This would again result in overheating of the heater element, with the danger of damage to the heater element itself and other parts of the laundry washing machine.

It is an object of the present invention to eliminate the above specified shortcomings by the provision of a laundry washing machine of the type described, the collector receptacle of which is designed and disposed so a to ensure that the laundering liquid contained therein is uniformly heated under thermostatic control in the course of any laundering programmed of the machine.

In addition, the washing machine according to the invention ensures efficient reclamation of any detergents deposited on the bottom of the collector receptacle, and the discharge from the receptacle of any fibres and foreign bodies. The machine is also provided with efficient safety features for protection against any malfuncion or damage of the heater element and the pressure switch.

these and other objects are attained according to the invention in a laundry washing machine comprising a washing chamber, a rotatable drum mounted in said chamber, and a washing liquid collector receptacle containing at least one filter element and communicating with a lower portion and an upper portion of said washing chamber through a flexible hose and a recirculation conduit and an electric recirculation pump, respectively, said collector receptacle additionally containing at least one electric heater element and thermostatic control means series-connected to said heater element and adjustable to control the heating of the washing liquid to selected temperatures.

The laundry washing machine according to the invention is characterized in that said collector receptacle additionally communicates with said electric recirculation pump through at least one further conduit effective during operation of said recirculation pump to return part of the washing liquid to said collector receptacle, and in that said thermostatic control means is series-connected to another thermostatic control means having a fixed response temperature of preferably about 90 °C.

The characteristics of the invention will become more clearly evident from the following description, given by way of example with reference to the accompanying drawings, wherein:

fig. 1 shows a diagrammatic front view of a laundry washing machine according to the invention,

fig. 2 shows a cross-sectional sideview of a structural detail of the machine of fig. 1, taken along the line A-A,

fig. 3 shows a diagrammatic view of a further structural detail of the machine of fig. 1 in a modified embodiment, and

fig. 4 shows an electric circuit diagram of certain functional components of the laundry washing machine according to the invention.

With reference to fig. 1, there is diagrammatically shown a laundry washing machine according to the invention, substantially comprising a housing 5, a washing chamber 6 mounted within housing 5 in a per se known manner, and a drum 7 for containing the laundry and adapted to be rotated by an electric motor 8 of conventional type secured to a lower portion of washing chamber 6.

Housed in an upper portion of the 4 machine is a detergent container 9 connected to the water mains through a conduit 10 and a solenoid valve 11 and provided with a flexible hose 12 connected to washing chamber 6 for the introduction thereinto of water and detergents.

The lower portion of washing chamber 6 is formed with an outlet opening 13 connected through a flexible hose 15 to a receptacle 15 for collecting the washing liquid draining from washing chamber 6, collector receptacle 15 communicating with the upper portion of washing chamber 6 through a conduit 16 connected to receptacle 15 through an electric recirculation pump 17.

Operation of electric recirculation pump 17 results in repeated recirculation of the washing liquid from collector receptacle 15 to washing chamber 6 for performing the various laundering programmes of the machine by irrigation of the laundry with the washing liquid. Collector receptacle 15 is designed to contain a fine-mesh filter element 18 of conventional type removably mounted in the receptacle for retaining particulate matter entrained by the washing liquid.

Collector receptacle 15 additionally accommodates at least one electric heater element 19 and two thermostats 20, 21 or similar sensors of conventional type adapted respectively to heat the washing liquid supplied to the receptacle and to control the temperature thereof.

In particular, heater element 19 is dimensioned so as to develop a considerable electric power for sufficiently rapid heating of the washing liquid, and is further adapted to be selectively energized for periods of varying duration under thermostatic control by thermostat 20.

Theremostat 20 is of the variably adjustable type and calibrated for a wide range of response temperatures comprised preferably between about 0 °C and 90 °C, permitting the washing liquid to be heated to different temperatures in the course of the laundering phases, depending on the nature of the laundry to be laundered.

Thermostat 21 on the other hand is of the fixed adjustment type and calibrated to an elevated response temperature of preferably about 90 °C so as to prevent the washing liquid from being heated beyond this maximum temperature.

To this purpose, thermostat 21 is operatively connected to thermostat 20 and heater element 19 in a manner to be described.

Collector receptacle 15 additionally communicates with electric recirculation pump 17 through a further conduit 22 connected to recirculation conduit 16 adjacent the outlet of recirculation 17, and with a flexible discharge hose 23 through a discharge pump 24 of the laundry washing machine operable to discharge the washing liquid from collector receptacle 15 to the exterior of the machine at the end of a washing cycle.

During operation of the electric recirculation pump 17, washing liquid taken from collector receptacle 15 is recirculated through conduit 16 to the interior of washing chamber 6, while part of this liquid is returned through conduit 22 into receptacle 15, resulting in a turbulent circulation of the washing liquid contained therein.

During the periods of operation of heater element 19, this turbulence results in a continuous agitation and mixing of the washing liquid contained in collector receptacle 15, so that the liquid is heated to a uniform temperature.

In this manner any possibility of temperature stratification in the washing liquid is eliminated.

As a result, the temperature of the washing liquid can be reliably controlled with the aid of one or the other of thermostats 20, 21.

The turbulence also prevents the formation of deposits on the heater element 19 of fibres from the laundry or any foreign bodies of reduced dimensions which are not retained by filter element 18, and ensures the discharge of such fibres and foreign bodies at the end of each laundering programme, as will be described. This overcomes the danger of a progressive reduction of the heat exchange surface area of the heater element 19, and thus of the amount of heat transmitted therefrom to the washing liquid.

Thanks to the fact that the above described shortcomings are thus avoided, the useful lifetime of the heater element is extended while ensuring proper heating of the washing liquid in desirably short periods of time.

The described turbulence also prevents detergent solids of small dimensions not retained by filter element 18 from being deposited on the bottom of receptacle 15 and thus being lost to the laundering process. Quite to the contrary, these detergent particles are intermixed with the washing liquid and entrained therein to the washing chamber via recirculation conduit 16. In this manner all of the detergent introduced into the washing chamber is efficiently osed.

Referring again to collector receptacle 15, it is noted that it is finally provided with a vertical partition 25 formed in one piece with a respective top wall portion 26 adjacent filter element 18 and extending to a location close above the bottom 27 of receptacle 15 so as to define an opening 28 for communication between two chambers 29 and 30 of the receptacle separated from one another by the partition.

Through a connected passage 31 of reduced cross-section chamber 29 also comminicates with a further chamber 32 housing the rotor 33 of discharge pump 24.

As a result of this construction, partition 25 within collector receptacle 15 Acts in the manner of a syphon permitting lose fibres and foreign bodies possibly deposited on bottom 27 of the receptacle to be discharged. This operation is carried out at the end of a laundering cycle of the machine by stopping recirculation pump 17 and energizing discharge pump 24 so as to discharge the washing liquid and any substances deposited on bottom 27 from collector receptacle 15 down to a level determined by the passage 28 defined by partition 25. As this level is situatged closely above bottom 27, the presence of the syphon formed by partition 25 ensures the efficient and practically complete discharge of such substances. This effect is not obtainable in the collector receptacles of known laundry washing machines, in which part of such substances always remains on the bottom of the receptacle.

The present laundry washing machine is also provided with at least one pressure switch 34 or similar liquid level control means acting to control the washing liquid supply to collector receptacle 15 to a reduced level.

In particular, pressure switch 34 communicates through a flexible hose 35 of reduced cross-section with a pressure sensing dome 36 itself formed integrally with collector receptacle 15 and a rectilinear tubular portion 37 adapted to be connected to washing chamber 6 of the machine through flexible hoe 14. As shown in fig. 2, pressure sensing dome 36 is formed at a lateral position with respect to tubular portion 37 instead of at a location on the top wall 38 of this portion as in conventional embodiments. This structural modification results in

the elimination of the difficulties caused by the presence of washing liquid vapours formed in the curse of laundering programmes from the machine by passing from collector receptacle 15 through flexible hose 14 towards washing chamber 6.

As in the present case pressure sensing dome 36 is disposed laterally of tubular portion 37 instead of on top thereof, any steam passing through tubular portion 37 connot possibly entrain any of the air contained in pressure sensing dome 36.

As a result of this construction, faulty indications of the washing liquid level by pressure switch 34 are reliably excluded in the course of the various laundering programmes to thereby ensure correct execution of the respective programmes with the proper washing liquid levels.

With reference to the washing chamber 6 of the laundry washing machine (fig. 1), it is noted that the upper part thereof is formed with a passage opening 41 sealingly connected to one end of a flexible sleeve 42, the other end end of which is connected to detergent container 9. Flexible sleeve 42 is also provided with a tubular spigot 43 for connection to recirculation conduit 16, and a partition 44 separating the outlet openings of sleeve 42 and recircul ation conduit 16 from one another. Sleeve 42 serves the purpose of conveying the washing liquid vapours escaping from collector receptacle 15 through flexible hose 14, from washing chamber 6 to the exterior of the machine through detergent container 9. Partition 44 on its part serves the purpose of properly directing the washing liquid recirculated via conduit 16 into washing chamber 6, thus preventing the liquid from flowing into sleeve 42 and finally into detergent container 9, which would otherwise result in the loss of part of the detergents dissolved in the liquid.

Shown in fig. 3 is a modified embodiment of the electric recirculation pump 17 of the present laundry washing machine. In this embodiment, pump 17 is provided with two separate outlets 45 and 46 connected respectively to recirculation conduit 16 and to conduit 22 communicating with collector receptacle 15, so that rotation of the rotor 47 of pump 17 causes the washing liquid to be expelled through both outlets 45 and 46 and to be thus circulated via both conduits 16 and 22 as in the precedent case. This construction thus likewise results in a turbulent circulation of the washing liquid through collector receptacle 15 for the same purposes as described above.

fig. 4 finally shows an electric circuit diagram of the above described components of the laundry washing machine. Heater element 19 is connected in series to the associated thermostats 20 and 21, the thus formed series-connected circuit being connected in parallel to electric recirculation pump 17 or directly to the electric power supply through a pair of electric switches 48 and 49 adapted to be opened and closed by respective associated cams of the (not shown) program control unit of the machine.

Discharge pump 24 of the machine is likewise connected in parallel to the electric power supply through a further switch 50 of the program control unit.

In this manner any laundering programme of the present machine is executed by closing the two switches 48 and 49 of the program control unit for simultaneously energizing the series-connected circuit formed by heater element 19 and thermostats 20 and 21, and electric recirculation pump 17, while switch 50 of the program control unit is maintianed in its open state, so that discharge pump 24 is not energized.

In the course of each laundering programme heater element 19 is thus intermittently energized and deenergized by the action of adjustable thermostat 20 previously adjusted to the required temperature of the washing liquid, whereby all of this liquid is uniformly heated to the required temperature without the formation of layers of different temperatures as in known embodiments, thanks to the fact that the liquid is recirculated through collector receptacle 15 via conduit 22 in the manner described above with reference to fig. 1.

Fixed thermostat 21 on its part is operable to automatically deenergize heater element 19 and thermostat 20 in response to the temperature exceeding its set value of preferably about 90 °C. This situation may be brought about for instance by the occurrence of a short-circuit in thermostat 20, which would otherwise result in the washing liquid being heated to its boiling point.

Fixed thermostat 21 thus acts as a safety device preventing the washing liquid from being heated to its boiling temperature with the resultant malfunctions as described earlier, namely; the entrapment of air bubbles in recirculation pump 17 with the resultant dry-running of the pump, as well as the overheating of heater element 19 within collector receptacle 15 which might be caused by the reasons explained above.

Claims

1. A laundry washing machine comprising a washing chamber, a rotatable drum within said chamber, and a washing liquid receptacle containing at least one filter element and communicating with a lower portion of said chamber through a flexible conduit, and with an upper portion of said chamber through a recirculation conduit and an electric pump, said collector receptacle also containing at least one electric heater element and

thermostatic control means connected in series to said heater element and adjustable for controlling the heating of the washing liquid to different temperatures, characterized in that said collector receptacle (15) additionally communicates with said electric recirculation pump (17) through at least one further conduit (22), so that during operation of said electric recirculation pump (17) part of said washing liquid is returned to said collector receptacle - (15) through said further conduit (22), and in that said thermostatic control means (20) is connected in series to a further thermostatic control means - (21) having a fixed response temperature of preferably about 90°C.

2. A laundry washing machine according to claim 1, characterized in that said further conduit - (22) has respective ends thereof connected to said collector receptacle (15) and to said recirculation conduit (16) adjacent the outlet of said electric recirculation pump (17).

3. A laundry washing machine according to claim 1, characterized in that said further conduit - (22) has respective ends thereof connected to said collector receptacle (15) and to a first outlet (46) of said electric recirculation pump (17), the latter being provided with a second outlet (45) connected to said recirculation conduit (16).

4. A laundry washing machine according to claim 1, wherein said collector receptacle is additionally connected to a discharge pump, characterized in that said collector receptacle (15) is provided with a vertical partition (25) formed in one piece with a respective top wall portion (26) adjacent said filter element (18) and said discharge pump (24), said partition (25) extending downwards to a location close to the bottom (27) of said collector receptacle (15).

5. A laundry washing machine comprising at least one pressure switch or similar level control device adapted to control the supply of washing liquid to said collector receptacle to a reduced level, said pressure switch being connected to an associated pressure-sensing dome, characterized in that said pressure-sensing dome (36) is formed in one piece with said collector receptacle (15) and a rectilinear tubular portion (37) adapted to be connected to the washing chamber (6) by said flexible conduit (14), and is located at a lateral position with respect to said tubular portion (37).

6. A laundry washing machine according to claim 1, characterized in that a top portion of said washing chamber (6) is formed with a passage opening (41) for receiving therein one end of a flexible sleeve (42) the other end of which is in communication with the exterior through the detergent container (9) of the machine, said flexible sleeve (42) being additionally provided with a tubular spigot (43) connected to said recirculation conduit (16), and a partition (44) adapted to separate the opening portions of said sleeve (42) and of said recirculation conduit (16) from one another.

7. A laundry washing machine according to any of the preceding claims, substantially as described with reference to the accompanying drawings and for the stated purposes.

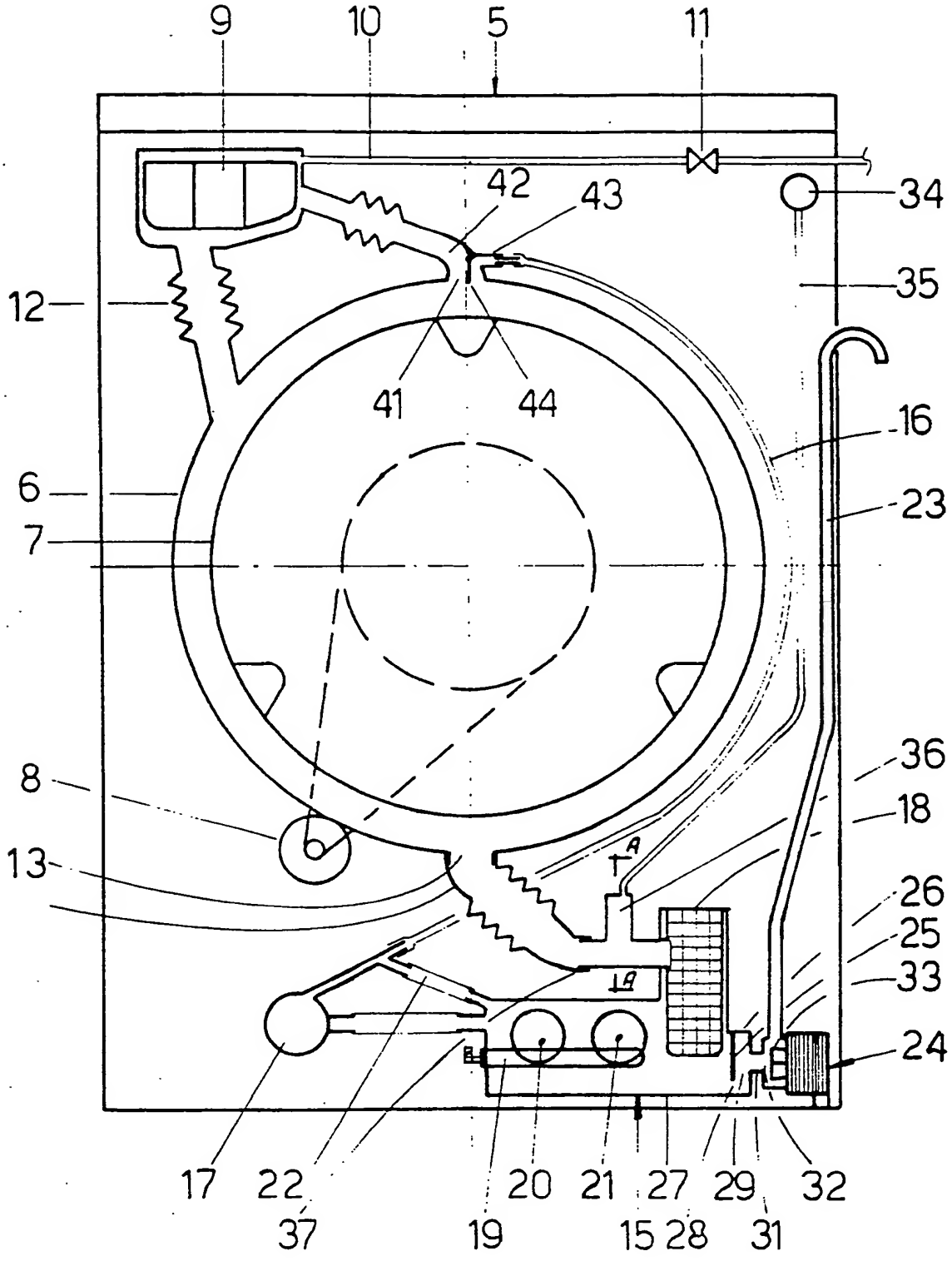
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FIG. 1

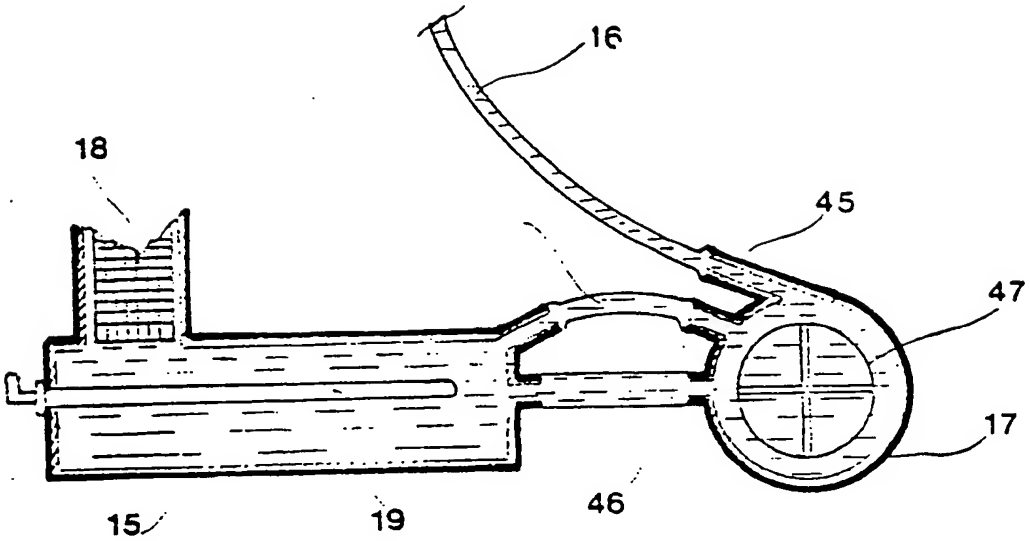

FIG. 3

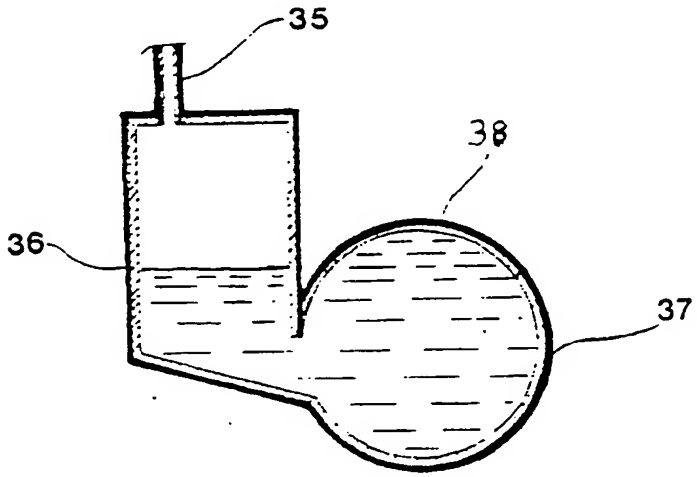

FIG. 2

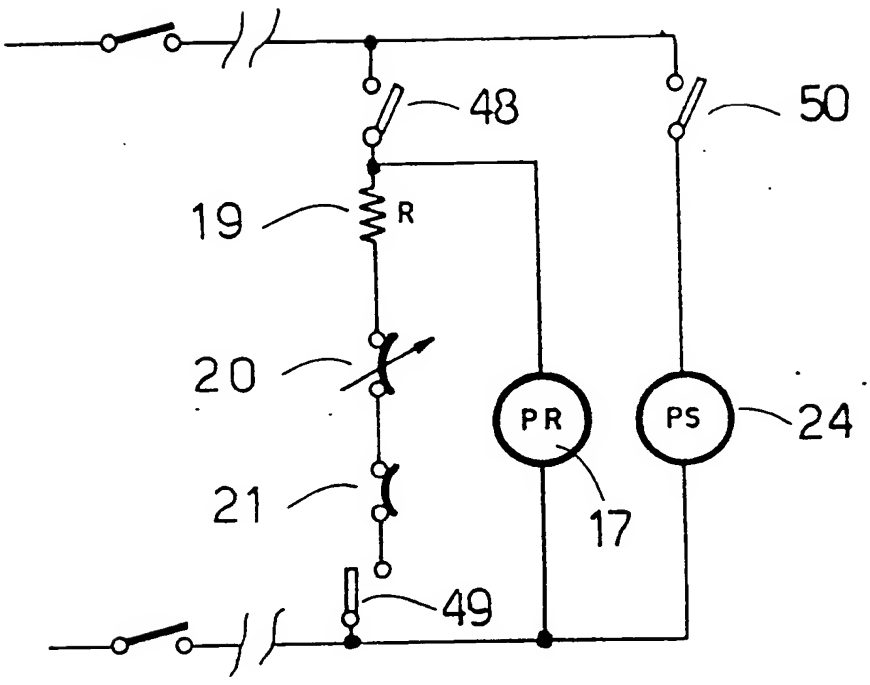

FIG. 4